Amendments to the Drawings:

The attached replacement sheets of drawings include a change to Figure 4, and replace the original sheets including Figs.1-6.

In Fig. 4, reference numeral "260" has been changed to —425—. All drawings have been formalized.

Attachments following last page of this Amendment:

Replacement Sheets (6 pages)
Annotated Sheet Showing Change (1 page)

REMARKS

Formal Matters

The Examiner has objected to the drawings, specifically Figures 4 and 5. Figure 4 has been corrected in response to this objection by replacing reference numeral 260 with "425" to identify the conduit, and page 9 of the specification has been amended to correct an error with regard to the numbering of Figure 4. Reference numeral 530 in original Figure 5 is somewhat smudged inadvertently giving the appearance of reference numeral 536. The formal replacement drawing for Figure 5 clearly shows reference numeral "530" to identify the aft manifold system as described in the specification. All drawings have been formalized. The replacement sheets of formal drawings are being sent to Drawings Review Branch under separate cover.

Claims 1 -21 are currently pending. Claims 1, 9 11 and 12 are amended herein. Claims 14 and 18-21 are cancelled herein.

Claim 9 has been rejected under 35 U.S.C. §112, second paragraph, due to an error in antecedence. This error has been corrected.

The Examiner has raised a double patenting rejection concerning claims 19-21, stating that these claims are substantially identical to claims 2-4. This problem stemmed from an error in dependency, and has been obviated by the cancellation of claims 19-21. Applicants respectfully request that this rejection be withdrawn.

Applicants' Claims

Claim 1, as amended, features an attitude control and propulsion system for a spacecraft. The system includes (a) a supply of oxidizer; (b) at least one attitude control nozzle that expels only the oxidizer; (c) a conduit fluidly coupling the supply of oxidizer and the attitude control nozzle, wherein the conduit provides a pathway for oxidizer to flow in a downstream direction from the supply of oxidizer toward and into the attitude control nozzle; and (d) a pressure regulator coupled to the conduit and interposed between the supply of oxidizer and the attitude control nozzle, wherein the pressure

regulator regulates the pressure of oxidizer at a location downstream of the pressure regulator and upstream of the attitude control nozzle to a set point pressure at or below a first pressure, wherein the first pressure comprises the pressure required to maintain the oxidizer in a gas state to ensure that the any oxidizer flowing through the conduit is in a gas state prior to entering the attitude control nozzle. The system also includes (e) a hybrid rocket motor having a main nozzle, the hybrid rocket motor including a combustion chamber in which the oxidizer interacts with a solid fuel to generate thrust via the main nozzle. The attitude control nozzle is positioned so that thrust produced by the attitude control nozzle adjusts the attitude of the spacecraft. The attitude control nozzle produces its thrust through the expansion of the oxidizer without combustion of the oxidizer as the oxidizer in the gas state is expelled from the attitude control nozzle.

Claim 12, as amended, features a method of controlling attitude and providing propulsion of a spacecraft. The method includes (a) providing a supply of oxidizer, wherein the supply of oxidizer contains oxidizer in both a liquid state and a gas state; (b) flowing oxidizer from the supply of oxidizer to a hybrid rocket motor of the spacecraft, wherein the hybrid rocket motor includes a combustion chamber and a main nozzle; (c) flowing oxidizer from the supply of oxidizer to an attitude control nozzle of an attitude control system of the spacecraft, (d) regulating the pressure of oxidizer flowing to the attitude control system, wherein the pressure is regulated to a pressure below the vapor pressure of the oxidizer for a temperature of the oxidizer at a location upstream of the attitude control nozzle to ensure that the oxidizer is in a gas state when flowing into the attitude control nozzle of the attitude control system; and (e) expelling only the oxidizer, in a gas state, from the attitude control nozzle to produce thrust through the expansion of the gaseous oxidizer without combustion of the gaseous oxidizer. Like claim 1, claim 12 requires a hybrid rocket motor with a main nozzle, as well as a separate attitude control nozzle of an attitude control system, with attitude-controlling thrust being produced by expelling only the oxidizer from the attitude control nozzle in a gas state without combustion of the oxidizer.

Rejection Under 35 U.S.C. §102(b)

Claims 1, 6 and 7 have been rejected as being anticipated by Smith. This rejection has been overcome by the amendment of claim 1. Smith does not teach or suggest Applicants' claimed combination of a hybrid rocket motor having a main nozzle, the hybrid rocket motor including a combustion chamber in which the oxidizer interacts with a solid fuel to generate thrust via the main nozzle; and at least one attitude control nozzle that expels only the oxidizer, wherein the attitude control nozzle is positioned so that thrust produced by the attitude control nozzle adjusts the attitude of the spacecraft and the attitude control nozzle produces its thrust through the expansion of the oxidizer, without combustion of the oxidizer, as the oxidizer in the gas state is expelled from the attitude control nozzle.

Instead, Smith is directed solely to chemical thrusters that combust vaporized propellants to adjust attitude. All of the nozzles disclosed in Smith produce thrust through combustion of a mixture of a first propellant and a second propellant. Thus, the nozzles disclosed in Smith do not expel only an oxidizer. In view of the foregoing, Applicants respectfully request that this rejection be withdrawn.

Rejections Under 35 U.S.C. §103(a)

Claims 1-7, 11, 12 and 14-21 have been rejected as unpatentable over Smith or Holzman in view of Hamke and optionally Jacobsen. Claim 13 has been rejected as unpatentable over these references further combined with Fix and optionally Whitehead, and claims 8-10 have been rejected as being unpatentable over any of these references further combined with Apfel. Applicants respectfully submit that these rejections have been overcome by the amendment of claims 1 and 13.

The art of record, whether taken alone or in any proper combination, does not teach or suggest the claimed system and method. Claims 1 and 12 relate to a system that includes a hybrid rocket motor with a main nozzle, as well as a separate attitude

control nozzle of an attitude control system, with attitude-controlling thrust being produced by expelling only the oxidizer from the attitude control nozzle in a gas state without combustion of the oxidizer.

As noted above, Smith is directed solely to chemical thrusters that combust a combination of vaporized propellants to adjust attitude. Holzman discloses a hybrid rocket motor that combusts a combination of a gaseous oxidizer (e.g., oxygen) with a solid fuel. Holzman fails to show an attitude control nozzle that expels only the oxidizer, in a gas state, from the attitude control nozzle to produce thrust through the expansion of the gaseous oxidizer without combustion of the gaseous oxidizer

Hamke discloses an attitude control system utilizing a primary thrust engine and an array of attitude adjustment engines, in which the engines may be either hybrid rocket engines that use liquid oxidant and solid fuel, bi-fluid combustion motors, or a combination thereof (see col. 4, lines 2-7 and 14-17, col. 6, lines 57-61). In Hamke, the attitude adjustment engines produce thrust via combustion of the fuel. Jacobsen relates only to reactors and techniques for decomposing nitrous oxide, while Fix and Whitehead describe fluid pressure control systems. Apfel describes systems that burn pressurized liquid fuel and oxidizer for both primary propulsion (the AKM) and attitude adjustment (the RCS thrusters). None of the references, either alone or in combination, teach or suggest expelling only an oxidizer, in a gas state, from an attitude control nozzle to produce thrust through the expansion of the gaseous oxidizer without combustion of the gaseous oxidizer.

It is believed that all of the pending claims have been addressed in this paper. However, failure to address a specific rejection, issue or comment, does not signify agreement with or concession of that rejection, issue or comment. Nothing in this paper should be construed as an intent to concede any issue with regard to any claim, except as specifically stated in this paper, and the amendment of any claim does not necessarily signify concession of unpatentability of the claim prior to its amendment.

Accordingly, Applicants submit that the claims as amended are patentable over the art of record and respectfully request that the rejections under §103 be withdrawn.

Respectfully submitted,

Date: January 23, 2006

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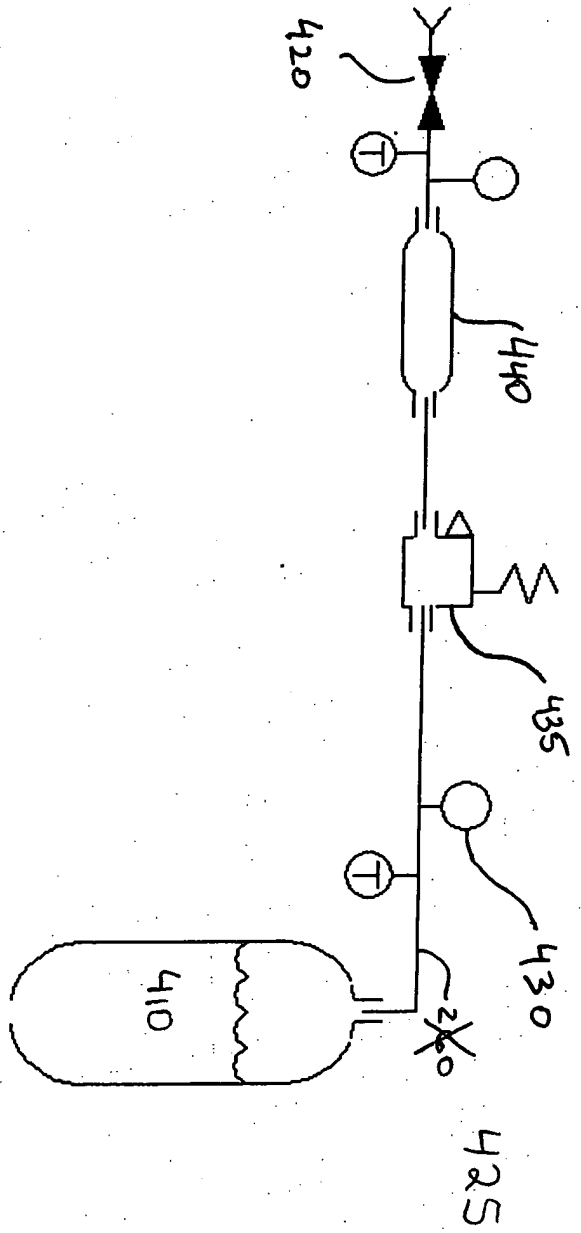

Figure 4